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Fast firmware update using host-to-module broadcast

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ABSTRACT

Firmware update is an important task for computer systems. Targets of firmware update includes memory (dynamic or non-volatile), FPGAs, ASICs, etc. It is often the case that there are several modules, e.g., NVDIMM modules, on a motherboard that are to be updated with the same firmware. Currently, the firmware is sequentially downloaded to each of the modules. However, sequential download and updation of module firmware is infeasible for systems that have large firmware size and a larger number of modules due to the time required for such update exceeding available maintenance time.

This disclosure describes using a broadcast technique to download firmware. A single host can provide identical firmware to several modules simultaneously. The total firmware download time is reduced by a factor equal to the number of simultaneously addressed modules.

KEYWORDS

- Firmware
- JEDEC
- I2C
- SMBus
- Host-to-module communication

BACKGROUND

JEDEC specification JESD245B describes procedures for upgrading the firmware image of hardware modules, e.g., non-volatile dual in-line memory (NVDIMM), dynamic double-rate RAMs (DDR-RAM), etc. The standard defines the protocol to be used, e.g., on the SMBus / I2C bus. The JEDEC specification currently offers firmware transfer speeds of up to 1 MHz, e.g., 100 kHz, 400 kHz, and 1 MHz. With increasing firmware complexity and size of multiple megabytes, the time taken to download a single firmware image is a sizeable fraction of the total available maintenance time for a computer system that uses such modules. Factoring in time spent by the module for checking individual blocks (e.g., using cyclic redundancy check), the time required to upgrade firmware for even a relatively small module can be close to or exceed the available maintenance time.

Further, systems can often include several modules on a motherboard, that each require upgrade of the same firmware or binary block. It is infeasible to complete firmware updates on all modules with available maintenance time if such updates are sequentially performed across modules. A reduction in firmware update time can be achieved somewhat by increasing the bus speed. However, there are electrical limitations to maximum bus speed. A smaller firmware image can reduce download time, but may be unsatisfactory due to reduced functionality of such firmware. Compression techniques can be used to create a smaller image without loss of functionality, but such gains are usually modest, e.g., in the range of 20-30%.

DESCRIPTION

Under current industry standards, there is no immediate provision for host-to-module broadcast, e.g., for the simultaneous download of firmware or binary block from a single host to several modules, e.g., multiple NVDIMM modules on a motherboard. Techniques of this

disclosure provide a mechanism for host-to-module broadcast, as well as a module-to-host unicast channel. The module-to-host unicast channel is used for acknowledgements of accurate receipt of downloaded firmware, e.g. CRC check bits, etc.

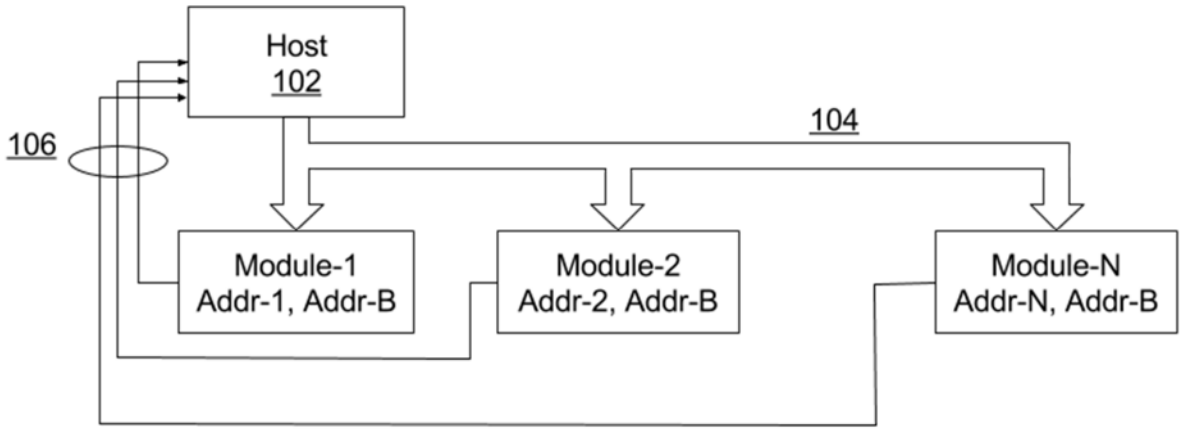

Fig. 1: Enabling host-to-module broadcast

Fig. 1 illustrates host 102 in communication with several modules denoted module-1, module-2, …, module-N. The host communicates with the modules over bus 104, e.g., an I2C or SMBus. The modules each communicate with the host through bus 106. P

Per techniques of this disclosure, each module has a unique address, and there is another address that is common to all modules. The unique address is denoted Addr-1, Addr-2, …, Addr-N. For example, Module-1 has unique address Addr-1, Module-2 has unique address Addr-2, etc. The address that is common to all modules is denoted Addr-B. All modules accept any I2C write transaction that is addressed to the common address, in addition to their own address. A module responds to I2C reads only if the module-specific unique address is used.

For the host to download firmware or otherwise communicate with a particular module, it invokes the address of that module. For the host to download common firmware to all modules, it invokes the common address Addr-B. Typically, a module unicasts back to the host over bus 106 the status, e.g., CRC-check, of the downloaded firmware.

In this manner, rather than downloading firmware in sequence, techniques of this disclosure provide a broadcast mode to for parallel, simultaneous download of firmware to all modules. Module-to-host communication happens over a bus, e.g., an I2C bus, and the host CPU uses that bus to poll or otherwise check status of each module individually. Per techniques of this disclosure, firmware update time is reduced by a factor of *N*, which is the number of simultaneously addressable modules. Techniques described herein can be combined with other download-time reduction techniques, e.g., firmware compression, to further speed up firmware upgrades.

CONCLUSION

Techniques of this disclosure speed the download of firmware common to multiple modules by introducing a broadcast mode that enables a host to communicate simultaneously with multiple modules. Downtime for equipment that uses firmware-based components, e.g., servers or cloud-based equipment using NVDIMMs, DDRs, ASICs, FPGAs, etc., is thereby reduced.